

Nosocomial Infections: Definitions

Infectious Disease Epidemiology Section
Office of Public Health
Louisiana Dept of Health & Hospitals
800-256-2748
www.oph.dhh.louisiana.gov

Your taxes at work

What is a Nosocomial Infection ?

- An infection which is acquired during hospitalization and which was not present or incubating at the time of admission
- An infection which is acquired in the hospital and becomes evident after discharge from the hospital
- A newborn infection which is the result of passage through the birth canal

What is a Nosocomial Infection ?

Practically - to establish that an infection is hospital acquired,

SHOW THAT the patient:

1. **HAS AN INFECTION**, not a simple colonization
2. **WAS NOT** infected at the time of admission
3. **HAD SUFFICIENT TIME** to develop infection

True Infection NOT Colonization



- Infections are accompanied by signs and symptoms:
 - → fever, malaise
 - → in localized infections: swelling due to inflammation, heat, pain, erythema (tumor, dolor, rubor, calor)
- Use definitions which establish minimum characteristics for infection
- **Remember:** Immunocompromised patients do not show signs of infection as normal patients. Neutropenic patients (≤ 500 neutrophils /mm³) show no pyuria, no purulent sputum, little infiltrate and no large consolidation on chest X-ray

NO Infection at Time of Admission

2

- **establish prior negativity**
- check history, symptoms and signs
- documented at time of admission, lab tests & chest X-rays done
 - normal physical examination
 - absence of signs and symptoms
 - normal chest X-ray
 - negative culture or lack of culture

Example: If urine cultures are collected at day 7 of hospitalization and none was collected before, it implies that no signs of infection were present in urine before

Sufficient Time to Develop Infection

3

- diseases with specific incubation period: stay in hospital \geq incubation period
- numerous infections do not have well set incubation periods (for example, staphylococci, *E.coli* infections)
 - these infections rarely develop in less than **2 days**

To establish a nosocomial infection, meeting the definition criteria is sufficient. There is no need to have proof *beyond the shadow of a doubt*

Case Definitions

CDC Definitions of Nosocomial Infections

Definitions of Nosocomial Infections

The ability of data collectors to define infections as nosocomial and identify their sites consistently is of paramount importance. Use of uniform definitions is critical if data from one hospital are to be compared with those of another hospital or with an aggregated database (such as the NNIS system).^{1,2} The NNIS system defines a nosocomial infection as a localized or systemic condition 1) that results from adverse reaction to the presence of an infectious agent(s) or its toxin(s) and 2) that was not present or incubating at the time of admission to the hospital (7, and *NNIS Manual*, Section XIII, May 1994, unpublished). For most bacterial nosocomial infections, this means that the infection usually becomes evident 48 hours (i.e., the typical incubation period) or more after admission. However, because the incubation period varies with the type of pathogen and to some extent with the patient's underlying condition, each infection must be assessed individually for evidence that links it to the hospitalization.

There are several other important principles upon which nosocomial infection definitions are based.¹ First, the information used to determine the presence and classification of an infection should be a combination of clinical findings and results of laboratory and other tests. Clinical evidence is derived from direct observation of the infection site or review of other pertinent sources of data, such as the patient's chart (detailed in a later section of this chapter). Laboratory evidence includes results of cultures, antigen or antibody detection tests, or microscopic visualization. Supportive data are derived from other diagnostic studies, such as x-ray, ultrasound, computed tomography (CT) scan, magnetic resonance imaging (MRI), radiolabel scan, endoscopic procedure, biopsy, or needle aspiration. For infections whose clinical manifestations in neonates and infants are different from those in older persons, specific criteria apply.

Second, a physician's or surgeon's diagnosis of infection derived from direct observation during a surgical operation, endoscopic examination, or other diagnostic studies or from clinical judgment is an acceptable criterion for an infection, unless there is

compelling evidence to the contrary (e.g., information written in the wrong patient's record, presumptive diagnosis that was not substantiated by subsequent studies). For certain sites of infection, however, a physician's clinical diagnosis in the absence of supportive data must be accompanied by initiation of appropriate antimicrobial therapy to satisfy the criterion.

There are two special situations in which an infection is considered nosocomial: (a) infection that is acquired in the hospital but does not become evidence until after hospital discharge and (b) infection in a neonate that results from passage through the birth canal.

There are two special situations in which an infection is not considered nosocomial: (a) infection that is associated with a complication or extension of infection already present on admission, unless a change in pathogen or symptoms strongly suggests the acquisition of a new infection, and (b) in an infant, an infection that is known or proved to have been acquired transplacentally (e.g., toxoplasmosis, rubella, cytomegalovirus, or syphilis) and becomes evident at or before 48 hours after birth.

There are two conditions that are not infections: 1) *colonization*, which is the presence of microorganisms (on skin, mucous membranes, in open wounds, or in excretions or secretions) that are not causing adverse clinical signs or symptoms, and 2) *inflammation*, which is a condition that results from tissue response to injury or stimulation by noninfectious agents, such as chemicals.

The information that follows contains the criteria that comprise the definitions of nosocomial infections (*NNIS Manual*, Section XIII, May 1994, unpublished). It lists the 13 major site categories and the 48 specific sites or types of infection for which criteria have been developed, beginning with the most frequently occurring sites of infection in hospitalized patients—urinary tract, surgical site, pneumonia, and primary bloodstream—followed by other sites of infection lists alphabetically by major site category (e.g., bone and joint, central nervous system).

Two additional points are important to understand with regard to definitions of nosocomial infections.⁴ First, the preventability or inevitability of an infection is

Garner JS, Jarvis WR, Emori TG, Horan TC, Hughes JM. CDC definitions for nosocomial infections. In: Olmsted RN, ed.: *APIC Infection Control and Applied Epidemiology: Principles and Practice*. St. Louis: Mosby; 1996: pp. A-1--A-20.

Blood Stream Infections BSI

Primary Lab Confirmed BSI

1 - Pathogen

- **Recognized pathogen from 1 or more blood culture**
- **Not related to infection at other site**

Primary Lab Confirmed BSI

2 - Contaminant

- One of following:
 - fever $>38^{\circ}\text{C}$
 - or chills
 - or hypotension $<90\text{ mm}$

- AND Common skin contaminant
 - from 2 or more blood cultures
 - drawn on separate occasions

- AND Common skin contaminant
 - from 1 or more blood cultures
 - with intravascular line
 - tx prescribed for infection

- AND positive antigen in blood for
 - *Haemophilus influenzae*
 - or *Neisseria meningitidis*
 - or group B streptococci

Primary Lab Confirmed BSI

3 - Pediatric

- One of following:
 - fever $>38^{\circ}\text{C}$ rectal
 - or hypothermia $<37^{\circ}\text{C}$
 - or apnea
 - or bradycardia

- AND Common skin contaminant
 - from 2 or more blood cultures
 - drawn on separate occasions

- AND Common skin contaminant
 - from 1 or more blood cultures
 - with intravascular line
 - tx prescribed for infection

- AND positive antigen in blood for
 - *Haemophilus influenzae*
 - or *Neisseria meningitidis*
 - or group B streptococci

Clinical Sepsis

ADULT

- One of following:
 - Fever $>38^{\circ}\text{C}$
 - or hypotension $<90\text{ mm}$
 - or Oliguria $<20\text{mL/hr}$
- AND no blood culture or negative blood culture
- AND no infection related to other site
- AND Tx ordered for sepsis

PEDIATRIC

- One of following:
 - Fever $>38^{\circ}\text{C}$ rectal
 - or hypothermia $<37^{\circ}\text{C}$
 - or apnea
 - or bradycardia
- AND no blood culture or negative blood culture
- AND no infection related to other site
- AND Tx ordered for sepsis

Secondary BSI

- Recognized pathogen from 1 or more blood culture(s)
- Related to infection at other site

Catheter Related Blood Stream Infection (BSI)

- **Similar microorganism in catheter colonization and blood culture**
- **Clinical evidence of BSI**
 - **Fever or hypothermia**
 - **± hypotension, tachycardia, tachypnea, confusion**

Surgical Site Infection SSI

Clean/Contaminated

- **Clean site:**
 - No inflammation
 - No penetration
 - Closed or with closed drainage
- **Clean Contaminated site:**
 - Respiratory, GI, genital or urinary tracts entered under controlled conditions with no unusual contamination
 - Specific site: biliary tract, appendix, vaginal, oropharynx

Clean/Contaminated Cont.

- **Contaminated site:**
 - Accidental wound with major breach in asepsis
 - Wound with massive GI spill
 - Sites entered with urinary, biliary infection, acute non-purulent infection
- **Dirty & Infected:**
 - Old wound with devitalized tissue, foreign bodies, fecal contamination
 - Perforated viscus
 - Pus

Classification

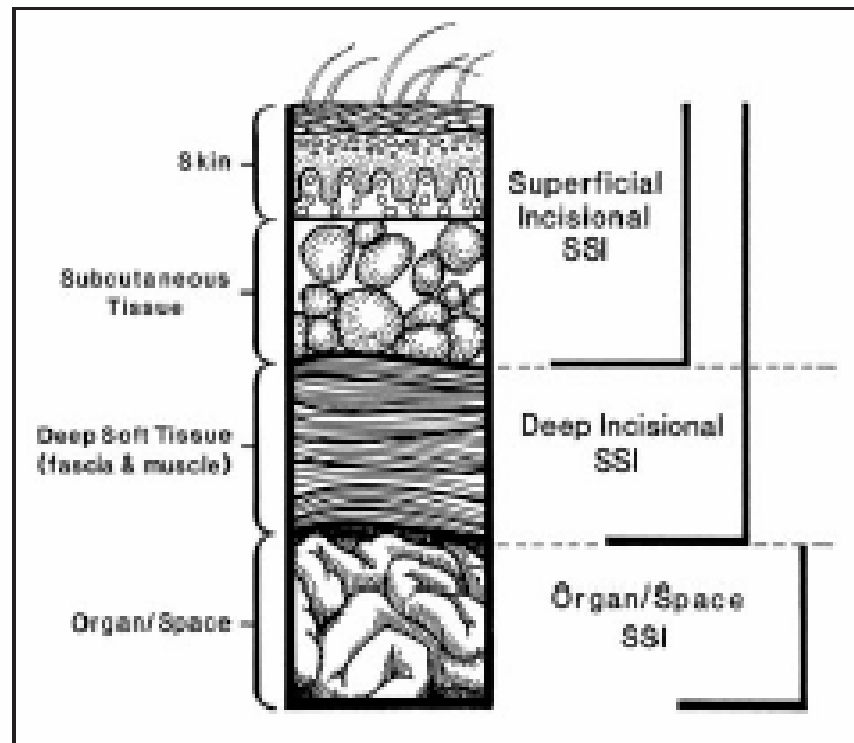


FIGURE. Cross-section of abdominal wall depicting CDC classifications of surgical site infection.²²

Infection occurs within 30 days after the operation if no implant is left in place

or

within 1 year if implant is in place and the infection appears to be related to the operation

Superficial SSI

- **PURULENT DRAINAGE** from superficial incision (Culture not indispensable)

or

- **Positive culture** from a closed surgical site obtained aseptically

or

- **One of : Pain or tenderness, localized swelling, redness, heat, wound dehiscence, abscess and of infection and wound reopening**

or

- **Medical diagnosis of SSI**

Not Superficial SSI

Stitch abscess

**Episiotomy, circumcision infection
(not operative figures)**

Infected burn wound

Deep Incisional SSI

Infection involves deep soft tissues (e.g., facial and muscle layers)

and at least *one* of the following:

1. Purulent drainage from deep incision but not from organ/space
2. Deep incision dehiscence or opened by surgeon when patient has at least one of: fever ($>38^{\circ}\text{C}$), localized pain, or tenderness, unless site is culture-negative
3. Abscess or other evidence of infection of deep incision on direct examination, re-operation, histopathologic or radiologic exam
4. Diagnosis of a deep incisional SSI by physician

- Report infection that involves both superficial and deep incision sites as deep incisional SSI
- Report an organ/space SSI that drains through the incision as a deep incisional SSI

Organ /Space SSI

Infection involves organs or spaces (other than incision) opened or manipulated during an operation

and at least one of the following:

- **1. Purulent drainage from a drain that is placed through a stab wound into the organ/space**
- **2. Organisms isolated from an aseptically obtained culture of fluid or tissue in the organ/space**
- **3. An abscess or other evidence of infection organ/space on direct examination, re-operation, histopathologic or radiologic examination**
- **4. Diagnosis of an organ/space SSI by physician.**

Urinary Tract Infection UTI

Asymptomatic Bacteriuria

- Very common among hospitalized patients
- Endogenous organisms:
 - Fecal flora colonizes perineum
- Exogenous organisms:
 - From HCW hands /collection containers
 - Colonize perineum
- Colonization progresses to meatal/urethral surface
 - Kass EH 1957, NEJM 256:55: *Serratia marcescens* applied to perineum, in 3 days some appeared in urine
 - Meatal colonization more important than length of urethra
Female at higher risk of meatal colonization
- Pyuria
 - Often absent
 - Suppression of immune response by catheter

Asymptomatic Bacteriuria -1-

- Patient with indwelling urinary catheter within 7 days before first culture

and

- Positive urine culture $\geq 10^5$ microorganisms per mL with no more than two species of microorganisms

and

- Patient has no fever ($\leq 38^\circ \text{C}$), urgency, frequency, dysuria, or suprapubic tenderness

Asymptomatic Bacteriuria -2-

- Patient with NO indwelling urinary catheter within 7 days before first culture
- and
- Patient with at least 2 positive urine cultures $\geq 10^5$ microorganisms /mL of urine with repeated isolation of same microorganism
- and
- no more than two species of microorganisms
- and
- Patient has no fever ($\leq 38^\circ \text{C}$), urgency, frequency, dysuria, or suprapubic tenderness

Symptomatic UTI -1-

- Patient has at least one of the following signs or symptoms with no other recognized cause:
fever ($\geq 38^{\circ}\text{C}$), urgency, frequency, dysuria, suprapubic tenderness

and at least 1 of the following:
 - Positive urine culture $\geq 10^5$ microorganisms per mL
 - Or urine with no more than two species of microorganisms

Symptomatic UTI -2-

- Patient has at least one of the following signs or symptoms with no other recognized cause:
 - fever ($\geq 38^{\circ}\text{C}$), urgency, frequency, dysuria, suprapubic tenderness
- and at least 1 of the following:
- Positive dipstick for leukocyte esterase or nitrate
- Pyuria (urine with ≥ 10 wbc/mm³ or ≥ 3 wbc/HPF unspun urine)
- Microorganisms seen on Gram stain of unspun urine
- At least 2 urine cultures with repeated isolation of same uropathogen (G neg bacteria or *S. saprophyticus*) with $\geq 10^2$ colonies/mL in non-voided specimens
- $\leq 10^5$ colonies/mL of single uropathogen (G neg bacteria or *S. saprophyticus*) in patient treated with UTI antimicrobial
- Physician diagnosis of UTI
- Physician institutes Tx for UTI

Symptomatic UTI -3- Pediatrics

- Patient <1 year of age with at least one of the following signs or symptoms with no other recognized cause:
fever ($\geq 38^{\circ}\text{C}$), hypothermia ($<37^{\circ}\text{C}$), apnea, bradycardia, dysuria, lethargy, or vomiting

and at least 1 of the following:

- Positive urine culture $\geq 10^5$ microorganisms per mL
- Or urine with no more than two species of microorganisms

Symptomatic UTI -4- Pediatrics

- Patient <1 year of age with at least one of the following signs or symptoms with no other recognized cause:
fever ($\geq 38^{\circ}\text{C}$), hypothermia ($\leq 37^{\circ}\text{C}$), apnea, bradycardia, dysuria, lethargy, or vomiting
and at least 1 of the following:
 - Positive dipstick for leukocyte esterase or nitrate
 - Pyuria (urine with ≥ 10 wbc/mm³ or ≥ 3 wbc/HPF unspun urine)
 - Microorganisms seen on Gram stain of unspun urine
 - At least 2 urine cultures with repeated isolation of same uropathogen (G neg bacteria or *S. saprophyticus*) with $\geq 10^2$ colonies/mL in non-voided specimens
 - $\leq 10^5$ colonies/mL of single uropathogen (G neg bacteria or *S. saprophyticus*) in patient treated with UTI antimicrobial
 - Physician diagnosis of UTI
 - Physician institutes Tx for UTI

Symptomatic UTI - 5

- **Positive culture of urinary catheter tip not acceptable laboratory test to diagnose UTI**
- **Urine cultures must be obtained using appropriate technique**
 - **Adult: clean catch collection or catheterization**
 - **Infants: bladder catheterization or suprapubic aspiration**
- **Positive urine culture from bag is unreliable and should be confirmed**

Respiratory Tract Infection RTI

Definition -1-

- Patient has rales or dullness to percussion on physical examination of chest
and
- at least 1 of the following:
 - new onset purulent sputum or change in sputum character
 - organisms cultured from blood
 - isolation of agent from specimen obtained by transtracheal aspirate, bronchial brushing, or biopsy

Definition -2-

- Patient has chest X-ray with new or progressive infiltrate, consolidation, cavitation, or pleural effusion

and

- at least 1 of the following:
 - new onset purulent sputum or change in sputum character
 - organisms cultured from blood
 - isolation of agent from specimen obtained by transtracheal aspirate, bronchial brushing, or biopsy
 - isolation of virus or viral antigen in respiratory secretions
 - diagnostic single antibody titer (IgM) or x4 ↑ in paired IgG
 - histopathologic evidence of pneumonia

Definition -3- Pediatrics

- Patient <1 year of age has at least 2 of following:
apnea, tachypnea, bradycardia, wheezing,
bronchi, or cough
- and
- at least 1 of the following:
 - new onset purulent sputum or change in sputum character
 - organisms cultured from blood
 - isolation of agent from specimen obtained by transtracheal aspirate, bronchial brushing, or biopsy
 - isolation of virus or viral antigen in respiratory secretions
 - diagnostic single antibody titer (IgM) or x4 ↑ in paired IgG
 - histopathologic evidence of pneumonia

Definition -4- Pediatrics

- Patient <1 year of age has X-ray with new or progressive infiltrate, cavitation, consolidation, or pleural effusion
- and
- at least 1 of the following:
 - new onset purulent sputum or change in sputum character
 - organisms cultured from blood
 - isolation of agent from specimen obtained by transtracheal aspirate, bronchial brushing, or biopsy
 - isolation of virus or viral antigen in respiratory secretions
 - diagnostic single antibody titer (IgM) or x4 ↑ in paired IgG
 - histopathologic evidence of pneumonia

Other Lower Respiratory Tract Infection

Other infections of the lower respiratory tract must meet at least one of the following criteria:

- Patient has organisms seen on smear or cultured from lung tissue or fluid, including pleural fluid
- or
- Patient has a lung abscess or empyema seen during a surgical operation or histopathologic examination
- or
- Patient has an abscess cavity seen

Do not report chronic bronchitis in a patient with chronic lung disease as an infection unless there is evidence of an acute secondary infection, manifested by change in organism

Ventilator Associated Pneumonia (VAP) -1

- Patient intubated, mechanically ventilated patient > 48 hrs of ventilation
 - Early onset: first 4 days
 - Late onset: after
 - Modified CDC definition:
 - Patient has chest X-ray with new or progressive infiltrate, consolidation, cavitation, or pleural effusion persisting >48hrs
- and 2 of the following
- Temperature $\geq 38^{\circ}\text{C}$ or $\leq 35^{\circ}\text{C}$
 - WBC $>10,000 /\text{mm}^3$ or WBC $<5,000/\text{mm}^3$
 - Purulent sputum
 - Pathogenic bacteria isolated from endotracheal aspirate

Ventilator Associated Pneumonia (VAP) -2

- Sensitive BUT NOT specific
- Poor correlation with autopsy
- Histo and culture of lung tissue remain gold standard
- Drug reactions, congestive heart failure, atelectasis, chemical aspiration, mimic nosocomial pneumonia
- Sputum cultures and endotracheal aspirates do NOT reliably identify pathogens responsible for VAP
- Better are:
 - Protected Specimen brush (PSB)
 - Broncho-Alveolar Lavage (BAL)
 - Protected Broncho-Alveolar Lavage (PBAL)